REMARKS

Claims 1-12 are now pending in the application. The amendments to the claims contained herein are of equivalent scope as originally filed} and, thus, are not a narrowing amendment. The Examiner is respectfully requested to reconsider and withdraw the rejections in view of the amendments and remarks contained herein.

REJECTION UNDER 35 U.S.C. § 103

Claims 1 and 3 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Sakai (U.S. Pat. No. 6,475,635). This rejection is respectfully traversed.

The features of the present invention claimed in claims 1 and 3 are as follows. A plated material of the present invention comprises a substrate (mainly made of Cu or Cu alloy) and a metal plating layer mainly made of Sn or Sn alloy formed on the surface of the substrate. As shown in Figs. 2 and 3, after the metal plating layer is subjected to reflow treatment by heating, the metal plating layer is converted to have a structure in which a soft region spreading in a network shape, and a hard region (6B) surrounded by the network of the soft region and both regions are coexisting in the tin plating layer. Analysis revealed that the soft region, made mainly of pure Sn metal, has a Vickers hardness of 20 to 250, and the hard region, made of Sn-Cu alloy formed by diffusion of Cu from the substrate into the plating layer of Sn by heat treatment, has a Vickers hardness of 60 to 700. The surface of the soft region in a network shape is located at higher vertical position than that of the surface of the hard layer, and the Vickers hardness of the hard layer is at least 30 higher than that of the soft region.

The Sakai reference discloses a bearing 1 having a copper alloy sliding material, which comprises a back metal 2 formed of a steel sheet, a bonding layer 3 made of a plating layer of copper, which is bonded onto the back metal 2, and a layer 4 of a copper alloy sliding material which is bonded on the bonding layer 3. The copper alloy sliding material is made to have a structure in which the hard copper phase and the soft copper alloy phase coexist. The copper alloy sliding material is formed by sintering a mixed powder of copper alloy powder containing at least Sn, and a copper alloy powder having at least one strengthening element selected from a group consisting of Ni, Co, Mn and Fe. In the sintering process, Sn contained in the copper alloy powder is diffused to form a Cu-Sn alloy soft phase, while the copper alloy powder having the strengthening elements is hardly migrate in the structure and the hard copper phase is formed. In the sintering process at a temperature of 800 to 920°C, Sn contained in the soft copper alloy powder diffuses to form a soft phase and strengthening elements contained in the copper alloy powder are hard to diffuse and form the hard phase. On the surface of the copper sliding material, the soft copper alloy phase comes to have a shape more concave than that of the hard material phase.

Differences of the Sakai reference with the present invention

The Sakai reference uses a plating layer of copper as a bonding layer for the copper alloy material, but does not use the plating layer of tin (Sn) for forming the surface layer.

The Sakai reference discloses that the copper alloy sliding material includes a hard copper phase having Vickers hardness of 87 to 257 and a soft copper phase having Vickers hardness of 85 to 138 (Table 1) coexisting in a mixed state. However,

the Sakai reference forms the soft copper phase by diffusion of Sn containing copper alloy powder in the sintering process, and forms the hard copper phase by using hard-to diffuse copper powder containing at least one strengthening element.

In contrast, in the present application, the soft region of the copper plating material is made of a tin layer made of plating, and the hard region is made of Sn-Cu alloy layer, which is formed by inhomogeneous diffusion of copper from the pretreated substrate into the plating layer of tin.

The Sakai reference discloses that, on the surface of the sliding material, the soft copper alloy phase comes to have a shape more concave than that of the hard copper alloy phase.

In contrast, in the present invention, the surface of the soft region is located at the position which is 0.2 to 10 μm higher than the surface of the hard region.

The Sakai reference limits the ratio (H_2/H_1) of Vickers hardness of the hard phase (H_2) to that of the soft phase (H_1) must satisfy the relation of (H_2/H_1) $\geqq$ 1.2. However, limitation of the hardness ratio of the present application is that the Vickers hardness of the hard copper region is 30 higher than that of the soft copper region.

In view of the foregoing remarks and amendments of claims 1, the Applicants respectfully request that the Examiner withdraw the rejection of claims 1 and 3.

ALLOWABLE SUBJECT MATTER

The Examiner states that claims 2, 4-6 would be allowable if rewritten in independent form. The Applicants have cancelled claim 2 and amended claim 4, so that the Applicants believe that the reasons for objections are resolved.

CONCLUSION

It is believed that all of the stated grounds of rejection have been properly traversed, accommodated, or rendered moot. Applicant therefore respectfully requests that the Examiner reconsider and withdraw all presently outstanding rejections. It is believed that a full and complete response has been made to the outstanding Office Action, and as such, the present application is in condition for allowance. Thus, prompt and favorable consideration of this amendment is respectfully requested. If the Examiner believes that personal communication will expedite prosecution of this application, the Examiner is invited to telephone the undersigned at (248) 641-1600.

Respectfully submitted,

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